Eike Hermann Müller

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- Strong passion for the **implementation and optimisation of numerical algorithms**
- More than 7 years of experience in **High Performance Computing** and software development in a wide range of languages (C/C++, Fortran 90/2003, Python)
- **Diverse background** in physics, applied mathematics and atmospheric modelling
- Successful contributions to **interdisciplinary research- and software- projects**
- Delivered **improvements for real- life operational** atmospheric modelling **codes**

Professional experience

- *Feb 2015 - present:* **Lecturer in Scientific Computing, University of Bath**

  To solve computationally challenging problems in science and engineering, I apply my expertise in scientific- and parallel- computing to the development of efficient numerical algorithms and their implementation in fast yet maintainable code. My current areas of interest are:

  - Massively **parallel multigrid solvers** with applications in weather- and climate- modelling
  - Algorithms for **GPUs and other novel architectures**
  - Fast matrix-free solvers for **higher-order Discontinuous Galerkin** discretisations
  - **Multilevel Monte Carlo** methods in atmospheric dispersion modelling
  - Development of a **performance portable molecular dynamics** framework

  To translate my work into improvements for real-life codes I collaborate closely with external partners such as the Met Office (UK weather- and climate forecasting agency).

- *Sep 2011 - Jan 2015:* **Research Associate (PostDoc), University of Bath**

  Department of Mathematical Sciences, Project PI: Prof. Rob Scheichl

  My work formed a vital part of the interdisciplinary GungHo! project with the goal of developing highly scalable algorithms for the numerical solution of the equations of atmospheric fluid dynamics.

  Main achievements: I analysed and implemented various bespoke iterative solvers (Krylov subspace methods, geometric multigrid) for anisotropic elliptic partial differential equations with up to $0.55 \cdot 10^{12}$ unknowns and successfully demonstrated their massively parallel scalability on 16384 GPUs on TITAN and on 65536 CPU cores on the HECToR supercomputer. I implemented a novel multigrid algorithm which improves the performance of the operational Met Office Unified Model code.

- *Nov 2009 - Aug 2011:* **Atmospheric Dispersion Scientist, Met Office, Exeter**

  Line Manager: Dr. Matthew Hort

  Main achievements: My implementation and optimisation of the OpenMP parallelisation of the operational NAME dispersion code led to a 10x reduction in model runtime and improved the Met Office's forecast capabilities. I contributed to the development of a new operational emergency response software system for volcanic ash events. For this I frequently interacted with users of the system such as Met Office forecasters.

Education

- *Sep 2006 - Nov 2009:* **PhD in Computational Particle Physics. Edinburgh**

  Supervisor: Dr. Alistair Hart, Title: "*Heavy-to-light decays on the Lattice*"

- *Oct 2000 - July 2006:* **Undergraduate studies in Physics (Siegen, Bonn, Edinburgh)**

  Completed with distinction (University of Bonn 2006). Due to my outstanding academic achievements I **won two highly competitive scholarships** during my studies:

  - Scholarship of DAAD (German Academic Exchange Service, *Sep. 2003 - Jul. 2004)* for funding a one year exchange at the University of Edinburgh
  - Scholarship of the Studienstiftung des Deutschen Volkes (German National Academic Foundation), which is awarded to the top 0.5 percent of the German university student population

Technical skills and interests

- Languages: C/C++ (advanced), Fortran 90/2003 (advanced), Python (intermediate), Java (basic)
- Parallel programming in MPI, OpenMP and CUDA-C
- Object oriented programming and design
- Numerical libraries (BLAS, LAPACK, DUNE, hypre, PETSc, Firedrake, PyOP2)
- Collaborative software development and tools (git, svn)

Collaborative software projects

I have frequently **collaborated** with academic colleagues and industrial partners on **software projects** of different scales (see list on webpage for details):

- **Performance portable geometric multigrid solvers** in the Firedrake/PyOP2 framework (with Dr. David Ham, Dr. Colin Cotter and Dr. Lawrence Mitchell, Imperial College)
- Geometric multigrid solver for flat spherical geometries in the DUNE C++ framework (with Dr. Andreas Dedner, University of Warwick)
- **Matrix-free solvers for higher-order DG** discretisations of elliptic problems in DUNE (with Prof. Peter Bastian, Dr. Steffen Müthing and Marian Piatkowski, Heidelberg University)
- **Bespoke multigrid solver** in the Unified Model Fortran 90 code (in collaboration with the Met Office)
- Design and development of a modular C++ code for the solution of stochastic differential equation in atmospheric modelling with multilevel Monte Carlo methods
- Supervision of a PhD project on the **development of a performance-portable framework for molecular dynamics** simulations.
- I am responsible for the design and implementation of scalable elliptic **solvers in the next-generation Met Office forecast model** (Fortran 2003, work carried out in collaboration with the Met Office).

Communication skills

I have successfully communicated the results of my research both in written and oral form (see webpage for full list of publications and talks).

Papers and conference presentations
- 14 peer reviewed publications in Scientific Computing, Numerical Mathematics, Monte Carlo methods, Software for Atmospheric Modelling and Theoretical & Computational Particle Physics) + 2 conference proceedings + 3 papers submitted
- *2009 - present:* Presentations at more than 20 national and international conferences and workshops

Due to my qualities as a speaker I have been **regularly invited to present** my work.
- *2012 - present:* 3 Invited seminar talks (Edinburgh 2015, Göttingen 2013, Warwick 2012), 5 invited conference/workshop talks (UK Fluids SIG 2017, CMWR Toronto 2016, Galerkin methods with appl. in NWP Edinburgh 2015, PMAA conference Lugano 2014, MAFELAP 2013, ECMWF workshop 2012)

Student supervision and teaching
I have shown that I can take the lead in supervising students both in larger groups and individually and demonstrated that I can explain complex ideas in scientific computing to a varied audience.
- *Sep 2014 - present:* Ongoing **supervision of 3 PhD projects**
- *Jan 2011 - present:* **Co-supervised 6 MSc level student projects in Scientific Computing** and contributed significantly to the design of the initial project description and plan in all cases
- *Summer Semester 2012 - 2017:* Teaching of **MSc level course on Scientific Computing**, Bath

Organisational skills

- *Jun 2016:* **Initiator and organiser** of international workshop on "Higher-order DG methods and finite element software for modern architectures" (Bath, ~30 participants)
- *Sep 2015:* **Minisymposium organiser**, ParCo 2015 conference, Edinburgh
- *Jun 2013, Jun 2014:* Scientific Organising Committee, Bath University HPC Symposium
   I served as an organiser of this annual one day meeting. My duties included selection of speakers, dissemination of email announcements and publicising the event.
- *Sep 2011 - present:* Successfully **applied for supercomputer access and managed time allocations on various national HPC resources** including HECToR, ARCHER and EMERALD

Languages: English (fluent), German (native speaker), Latin (basic knowledge)